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ABSTRACT

This study evaluated the effects of instructional scaffolding interventions (ISI) on preservice teachers' knowledge structures (e.g., concept maps) and short essay responses over time. Participants were 60 preservice teachers from two universities who were enrolled in one of three introductory psychology courses. One course was used as the experimental group, and the other courses became the comparison groups. ISI interventions consisted of a series of guided informational feedback sessions, following concept mapping and writing activities. The interventions were initiated in the experimental group to support learning that would enable higher levels of short essay responses, particularly among lower achieving students. Short essay question sheets were used to assess participants' written expressions of conceptual understanding of motivation theory. A three-group, multivariate repeated measures design was used to compare the knowledge structure and short essay responses of students in both conditions. Seven criteria were used to judge the quality of each concept map. Results indicated that students' declarative and procedural knowledge, as well as metacognitive skills, developed. The expert-novices had a more developed knowledge of subject matter content, they knew how to represent their knowledge when engaged in a concept mapping task, and they were more aware of the task demands and the audience when engaged in a writing task. The appendixes present examples of concept maps and short essay responses, examples of students' concept maps with other students' feedback comments, and examples of collaborative concept maps. (SM)

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ED 429 943

# INSTRUCTIONAL SCAFFOLDING INTERVENTION AND CONCEPT MAPPING OUTCOMES AMONG DIVERSE LEARNERS IN A PRE-SERVICE EDUCATIONAL PSYCHOLOGY COURSE: A MODEL FOR DEVELOPING EXPERTISE IN WRITING EXPRESSIONS OF CONCEPTUAL UNDERSTANDING

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C. Coco

## ABSTRACT

The present study was designed to evaluate the effects of instructional scaffolding interventions (ISI) on pre-service teachers' knowledge structures (i.e., concept maps) and short essay responses over time. Instructional scaffolding interventions consisted of a series of guided informational feedback sessions. A total of 60 pre-service teachers from *two* mid-western universities participated in the study. Participants were enrolled in one of three *Introduction to Educational Psychology* courses that were taught by the investigator during the spring term of 1998. One of the courses was used as an experimental (i.e., intervention) group (X1b). Whereas, two of the courses were used as comparison groups (X2b-X3b). The experimental (n = 20) and comparison group 1 participants (n = 20) were enrolled at a state-supported university. The comparison group 2 participants (n = 20) were enrolled at a private, Roman Catholic university. A three-group, multivariate repeated measures design was used to compare the knowledge structure and short essay responses of students in intervention and non-intervention classroom conditions. Seven criteria were used to judge the quality of each concept map. The combined map and essay score for phase 3 was significantly different between the experimental group and comparison group 1 (F = 6.565, N = 20, Sig. = .020, observed power = .679). Mean total score for the experimental group was 33.10, n = 20, SD = 10.68. Whereas, mean total score for the comparison group 1 was 24.80, N = 20, SD = 11.46.

Comparison group 2 participants had the highest mean total score (map and essay combined) for phase three (M = 34.90, N = 20, SD = 9.73). A one-way

ANOVA revealed a significant difference between all groups for phase three on the dependent measure scores (map and essay combined) (F = 5.12, N = 60, Sig. = .009). A Tukey HSD post-hoc procedure applied to the phase three data set revealed a significant mean difference between comparison group 1 and comparison group 2 (MD = 10.10, Sig. = .011). There was also a significant mean difference between the experimental group and the comparison group 1 (MD = 8.30, Sig. = .044). Implementing ISI interventions may be more necessary at institutions with demographic characteristics that are similar to the experimental and the comparison group 1 participants.

Fourteen sets of retrospective think-aloud protocol comparisons were made between higher- and lower-achieving students (i.e., expert- and struggling-novices) at the conclusion of the study. Expert-novices expressed more declarative knowledge of motivation theory; talked more about the procedures of forming a concept map (the "how-to's); and expressed more preoccupation with the demands of the task (i.e., answering the question, staying on-task). Furthermore, the expert-novices expressed the effectiveness of concept mapping on writing ability more favorably than the struggling-novices. The findings of this study imply that declarative and procedural knowledge, as well as metacognitive skills develop. That is, the expert-novices have a more developed knowledge of subject-matter content. At the same time, the expert-novices know "how to" represent their knowledge (when engaged in a concept mapping task) and are more aware of the task demands and the audience (when engaged in a writing task).

**Purpose and Overview of the Study**

The present study was designed to evaluate the effects of instructional scaffolding interventions on students' knowledge structures (i.e., concept maps) and short essay responses. Instructional scaffolding interventions (ISI) were initiated in an experimental group in order to support learning that would enable higher levels of short essay responses, particularly among lower achieving students. A series of outcome measures were compared across experimental and comparison conditions. Readings addressing motivation theory provided the "content" of the unit and were complimented by the use of vignettes. In the conceptual framework presented in **Figure 1**, emphasis is given to instructional scaffolding interventions (an instructional method).

**Theory that Grounds Instructional Scaffolding**

*Vygotsky's Scaffolding Theory* (Vygotsky, 1962) has been reviewed from different perspectives. I will attempt to share what I believe Vygotsky intended as applied to the teaching of educational psychology. The emphasis is on the process and how a struggling-novice arrives and moves through the zone of proximal development with the assistance of another learner (i.e., an expert-novice) with greater knowledge and experience than themselves. It is held that the "social" or "community" support in an educational psychology class can help the struggling student build the necessary scaffolding to gain greater knowledge. The higher-achieving student can help the learner move to a new level of overall knowledge and understanding. It is not a 'one shot deal' but rather a continual process of growth as the learner gains better understanding in the social environment.

**Theory that Grounds Concept Mapping**

It is still a mystery how knowledge is stored, but cognitive researchers offer the *schema theory*. A schema is a generalized mental model that is used to organize memory, to focus attention, to interpret experience, and to codify actions. A schema is similar to a prototype or template, except that schema is active, self-activating, self-revising processes.

As Anderson and Pearson (1984) explain it, schemas are:

- **structured** (they represent relationships among component parts).
- **dynamic**--they change, develop, interact.
- They **provide context** and **vocabulary** for interpreting what we read.
- They **organize experience** and **modify themselves** to accommodate new experiences.

Having a rich, elaborated schema is frequently used to explain the effectiveness of problem solving among experts who have arranged and stored information in an orderly fashion (Bruer, 1993). For example, an individual's schema for the concept of *cognitive development* might include two, equally weighing ideas – "Piaget's Theory" and "Vygotsky's Perspective" with the following subcategories associated with Piaget: the four stages of development, basic tendencies, and limitations of Piaget's theory. Another associative chain might link Vygotsky with terms such as, zone of proximal development, scaffolding, dynamic assessment, and implications for teachers.

New information can have several effects on a reader's existing knowledge structures. Three effects identified by Rumelhart and Norman (1978) include:

- **Accretion:** The new information may fit into a slot in an existing schema, and thus be quickly comprehended.

- **Restructuring:** A reader may use new information to create a new schema. (Eating certain things can help prevent cancer; oat bran is one of those.)
- **Tuning:** A reader may use new information to "tune" an existing schema so it is more accurate, complete, or useful. (Oat bran does not help prevent cancer after all, but other foods seem to.)

These activities are essentially the same as Piaget's categories of assimilation, accommodation, and equilibrium.

**Participants**

A total of 60 pre-service teacher certification students from *two* mid-western universities participated in the study. Participants were enrolled in one of three *Introduction to Educational Psychology* courses that were taught by the investigator during the spring term of 1998. One of the courses was used as an experimental group (X1b) and two of the courses were used as comparison groups (X2b-X3b). The experimental group participants consisted of 20 students who were enrolled at a public, state-supported university. The comparison group 1 participants ($\underline{n}$ = 20) were enrolled at a state-supported university. The comparison group 2 participants ($\underline{n}$ = 20) were enrolled at a private, Roman Catholic university. The rationale for including participants from a private university (i.e., comparison group 2) was to compare their performance levels with students from a state-supported institution.

**Setting and Classroom Context**

The three courses were taught at two fairly large, urban campuses. The state-supported university awards bachelor's and master's degrees with a total enrollment of 10,035 students. Whereas, the private Roman Catholic institution awards doctoral and professional degrees in addition to bachelor's and master's degrees. Total enrollment at the private institution was greater (13,759) than at the state-supported university. At the

state-supported university, 15 percent of entering students scored at or above 21 on the ACT (American College Test) examination (Peterson, 1998). Whereas, at the private university, 83 percent of entering students scored at or above 21 on the ACT examination. Annual tuition and fees for students at the state-supported university was less ($2,657) than at the private university ($14,820).

The textbook used in all of the courses was the seventh edition of *Educational Psychology* (Woolfolk, 1998).

**Design**

A three-group, multivariate repeated measures design was used to compare the knowledge structure and short essay responses of students in intervention and non-intervention classroom conditions. The *independent variables* were: phases of study (X1a-X3a); groups (X1b-X3b); and types of learners (X1c-X2c). The *dependent variables* were quality of concept maps (Y1, Y3, Y5) and written expressions of conceptual understanding (Y2, Y4, Y6). The analytic paradigm is illustrated in **Figure 2**.

**Dependent Variables**

The following dependent measures were used:

a) *Concept Map Representations*. A self-constructed, concept map representation sheet was used to assess the quality of students' conceptual representations of motivation. Concept map work sheets were administered to all participants in the experimental group and the comparison group 1 during *each* phase of the study. It should be noted that the comparison group 2 was administered the concept map work sheet only during phase 3 of the study. The concept maps were scored according to criteria developed by the investigator. Seven criteria were used to

judge the quality of each concept map: 1) *inclusiveness of content* – the degree to which different motivational theories were included in the concept map; 2) *explanatory focus* – the degree to which the concept map explained student motivation; 3) *fluency* – the degree to which key terms were used in the concept map; 4) *breadth* – the degree to which broad categories were used in the concept map; 5) *depth of categorization* – the degree to which subsuming terms were used to describe each category; 6) *interpretability* – the degree to which the structure of the concept map is understood or brings about meaning; and 7) *originality* – the degree to which the structure or design was used by fewer than 5-10% of the participants. The investigator assigned a score on a five-point scale (1 – 5) to each of the criteria listed above. A score of five points on any criteria indicated excellence; three points - satisfactory work; one point - needs improvement. (Four points and two points were assigned for work that appeared to fall in between the extreme categories and the mid-point). A perfect map received a total score of thirty-five points.

*b) Short Essay Question Sheets*. Short essay question sheets were used to assess the participants' written expressions of conceptual understanding of motivation theory. Short essay question work sheets were administered to the experimental group and to the comparison group 1 during *each* phase of the study. Once again, it should be noted that the comparison group 2 was administered the short essay question sheet only during phase 3 of the study. Three criteria were used to judge the quality of essay responses in each phase of the study: 1) *inclusiveness of content* – the degree to which different motivational theories were included in the essays; 2) *explanatory focus* – the degree to which the written responses *explained* human motivation; and 3) *fluency* – the

degree to which key terms were used in the written responses. A score on a five-point scale (1 – 5) was assigned to each of the three criteria described above. A perfect essay received a fifteen point total score.

The results reported in **Table 1**, indicate that the intercorrelations between the seven criteria used to assess the quality of the concept maps (e.g., inclusiveness of content, explanatory focus, fluency, etc.) and the three criteria used to assess the quality of written essays (e.g., inclusiveness of content, explanatory focus, fluency) were significant. In fact, most correlations were significant at the 0.01 level (2-tailed, N = 121). In addition, a Pearson Product correlation coefficient revealed a positive relationship between the concept map scores and the essay scores ($r$ = .568, N = 116, p. < .01, 2 - tailed) **(see Table 2 and Figure 3).**

The 30 coded data sets by three independent raters were found to be consistent (i.e., reliable) with each other. Interrater reliability for each criteria was reported in terms of standard deviations and analysis of variance (ANOVA) indexes. The standard deviations among each data-coder were compared on each criteria used to assess maps and essays. The standard deviations of the scores for each rater were found to be similar. The ANOVA results suggest that there are no significant differences between raters on any of the criteria **(see Table 3).**

**Methodology**

A unit on classroom motivation was introduced in all groups. Students were given an overview of the motivation theories that they were going to be responsible for learning, such as: Maslow's hierarchy of needs; behavioral perspectives, expectancy X value perspectives, and contemporary attribution theoretical perspectives. Prior to the

mapping and writing activities, the investigator distributed examples of possible schematic mapping structures to the participants (e.g., hierarchy, sequence, descriptive, compare/contrast, cause-effect, network, cycle).

Experimental Group. Instructional scaffolding interventions (ISI) *followed* concept mapping and writing activities (see **Appendix A** for examples of concept maps and short essay responses). ***Instructional scaffolding interventions (ISI)*** consisted of a series of guided informational feedback sessions. ISI was used as a method of instruction to support struggling-novices by giving increasingly specific hints to help the student develop an appropriate schematic representation of motivation theory. A six-page packet containing a prior selection of students' concept maps of motivation were handed-out to each member of the class. The packet contained a random and representative collection of low-quality to high-quality conceptualizations of human motivation. In small groups, students were instructed to provide written feedback regarding the quality of the map structures contained in the packet (refer to **Appendix B** for examples of students' concept maps with other students' feedback comments). Each group was then asked to create a "collaborative concept map" that would combine the existing, individually crafted schemas to form a new and more complex collaborative concept map. Participants could either use the feedback to revise their work or take it as encouragement to continue in the direction they had chosen (see **Appendix C** for examples of collaborative concept maps). Each group presented their newly configured and collaboratively determined concept map to the whole class using an overhead projector. Ideally, through this collaborative activity, the "social" or "community" support in the class would help the struggling-novice build the necessary scaffolding to gain

greater knowledge. The expert-novices in the class could help struggling-novices move to a new level of overall knowledge and understanding. Struggling-novices could learn how to organize their knowledge, and eventually could use concept mapping independently as a learning strategy. The investigator and voluntary class members took the role of scaffolds to provide guidance to other class members. The goal was to communicate to others the information that was relevant and/or irrelevant to the task. The instructor along with several vocal students gave increasingly specific hints to help other students develop an appropriate schematic representation of motivation theory. It was important to have students recognize what they knew of motivation theory, as well as what they did not yet understand.

**Major Findings**

A MANOVA revealed an overall, non-significant difference between the experimental and comparison group 1 on the dependent variables (Wilks' Lambda value = .700, F value = 2.29, N = 20, Sig. = .117 with observed power = .472) (**see Table 4).** However, a univariate analysis of variance indicates that the combined map and essay score for phase 3 (Total Y5Y6) was significantly different between groups (F = 6.565, N = 20, Sig. = .020, observed power = .679). In fact, mean total score for the experimental group for phase 3 was 33.10, n = 20, SD = 10.68. Whereas, mean total score for the comparison group 1 for phase 3 was 24.80, N = 20, SD = 11.46 (see **Table 5 and Figure 4**).

Comparison group 2 participants had the highest mean total score (map and essay combined) for phase three (M = 34.90, N = 20, SD = 9.73) **(see Table 6 and Figure 5).** A one-way ANOVA revealed a significant difference between all groups for

phase three on the dependent measure scores (map and essay combined) (F = 5.12, N = 60, Sig. = .009) **(see Table 7).** A Tukey HSD post-hoc procedure applied to the phase three data set revealed a significant mean difference between comparison group 1 and comparison group 2 (MD = 10.10, Sig. = .011). There was also a significant mean difference between the experimental group and the comparison group 1 (MD = 8.30, Sig. = .044) **(see Table 8).**

More participants in the experimental group (n = 8) than in the comparison group 1 (n = 4) were identified as expert-novices in the last phase **(see Figures 6 and 7)**. An ***expert-novice*** was operationally defined as having a total score of 40 points or greater based on a total assessment of concept map and written essay scores. A ***struggling-novice*** was operationally defined as having a total score of 39 points or less based on concept map and essay scores. Fourteen sets of retrospective think-aloud protocol comparisons were made between expert- and struggling-novices at the conclusion of the study. Expert-novices expressed more declarative knowledge of motivation theory; talked more about how they were going to form associative links within broad categories and the positioning of words; and expressed more thought to the demands of the task (i.e., answering the question, staying on-task). Furthermore, the expert-novices expressed the effectiveness of concept mapping on writing ability more favorably than the struggling-novices.

**Implications**

The non-significant difference between the experimental group and comparison group 1 on the dependent variables deserves attention. This unexpected finding may be due to a relatively weak experimental manipulation. A failure to maximize experimental

variance across groups may have lead to a type II error (i.e., accepting a false $H_o$). It should be taken into account that *only one* instructional scaffolding intervention (ISI) session took place between each test phase, resulting in only a total of two ISI sessions. Possibly, *more* ISI sessions may have been necessary (i.e., between each test phase) to maximize the variance between groups.

The finding that more participants in the instructional scaffolding intervention group (experimental group) were identified has expert-novices toward the end of the study was of considerable interest. This finding suggests that ISI interventions *gradually* help to improve knowledge structure of motivation theory and written expressions of applied theoretical understanding. Given that the ISI sessions involved considerable task engagement (i.e., the investigator handing-out packets of other students' concept maps; student assessments of the concept maps according to explicit criteria; and small-group activities that required each group to create and present a "group" concept map of motivation) it should not be surprising to find that the accumulation of these activities helped to increase the number of expert-novices. Based on this analysis, it can be inferred that when confronted with an experience discrepant to existing concepts, participants in the ISI intervention group were more likely to change their conceptions about core concepts, replace them with new ones, thus effecting written responses. Whereas, those participants not receiving the ISI interventions were less likely to change their conceptions about core concepts, thus resulting in lower quality essay responses.

Given that the quality of concept maps and essay responses improved over time indicates that students' knowledge structures about motivation theory were relatively

undeveloped at the beginning of the course unit (first phase) and became more developed by the end of the unit (third phase). This is impressive given that students' maps and essays *were not* compared during the class to some incontestable, exemplary structure or essay. That is, improvements were made over time *without* the premise that progress equated with the degree of resemblance between participants' work and some "model" as presented by lecture, or by the instructor's concept map. In fact, it should be noted that no "exemplary" structure or essay was presented during class, nor did the textbook provide the reader with a concept map of motivation.

The finding that the participants in the comparison group 2 had the *highest* mean total score (map and essay combined) for phase three strongly suggests that the differential demographic characteristics across groups were related to dependent measure scores. Let us consider the conditions and characteristics of the comparison group 2 participants. Neither in-class concept mapping activities, nor ISI sessions occurred for the comparison group 2 participants. In fact, only a post-assessment of concept map structures and short essays was obtained during the third phase of the study via a unit exam. Furthermore, the comparison group 2 participants were enrolled at a selective, private, Roman Catholic university. Only 10 percent ($\underline{n}$ = 2) of the comparison group 2 participants were from under-represented groups. Whereas, the experimental group and comparison group 1 participants were enrolled at a less selective state-supported institution in which eighteen percent of the participants ($\underline{n}$ = 7) were from under-represented groups. The point here is that implementing instructional scaffolding interventions may be more necessary at institutions with demographic

characteristics that are similar to the experimental and the comparison group 1 participants.

**Limitations**

The collection of ACT scores or a measure of motivation, or other construct among all participants would have helped to make better sense of *why* comparison group 2 out-performed the other groups in phase three.

**Future Directions**

Some directions that teachers of educational psychology may pursue regarding pre-service teachers' knowledge structures of educational psychology content are listed below:

- Application of ISI interventions to other units of instruction in the educational psychology course (e.g., intelligence, cognitive development, and individual differences) is warranted.
- Video-taping pre-service educators and students engaged in ISI sessions to better describe what was said and done.

**Conclusion**

The findings from this investigation contribute to the literature in educational psychology in two important ways: First, in considering the questions, "What develops among pre-service teachers? The findings of this study imply that declarative and procedural knowledge, as well as metacognitive skills develop. That is, the expert-novices have a more developed knowledge of subject-matter content. At the same time, the expert-novices know "how to" represent their knowledge (when engaged in a

concept mapping task) and are more aware of the task demands and the audience (when engaged in a writing task).

Secondly, the present investigation contributes to the field of educational psychology by providing instructors with conclusive research findings regarding the methods to teach educational psychology. That is, instructional scaffolding interventions together with concept mapping activities can, in certain settings, be beneficial classroom strategies to implement.

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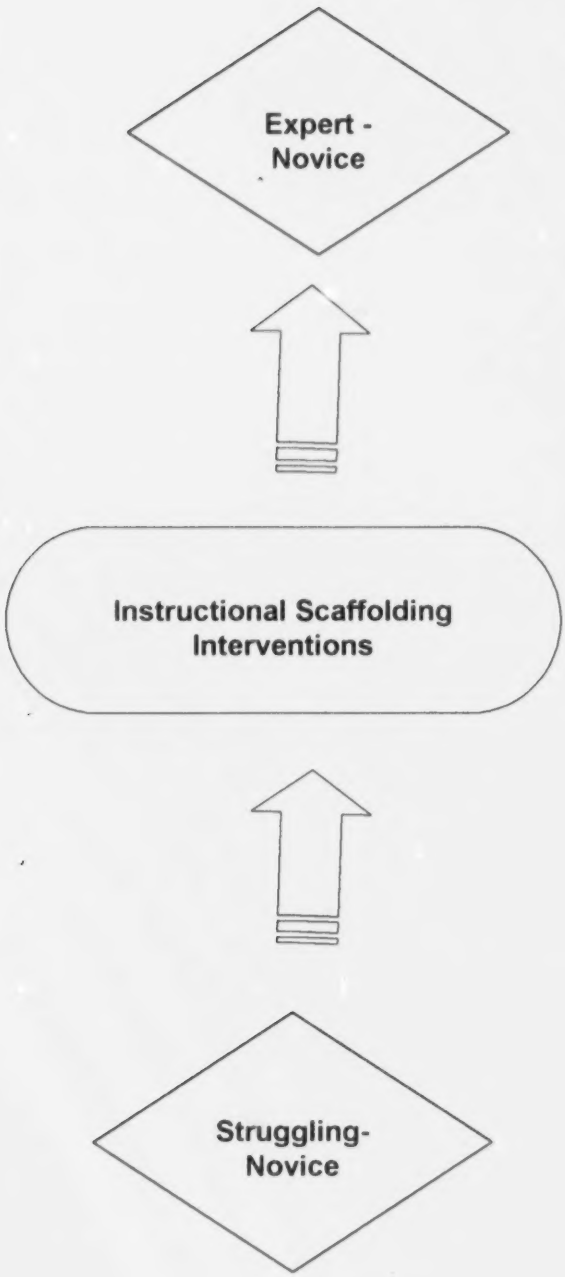
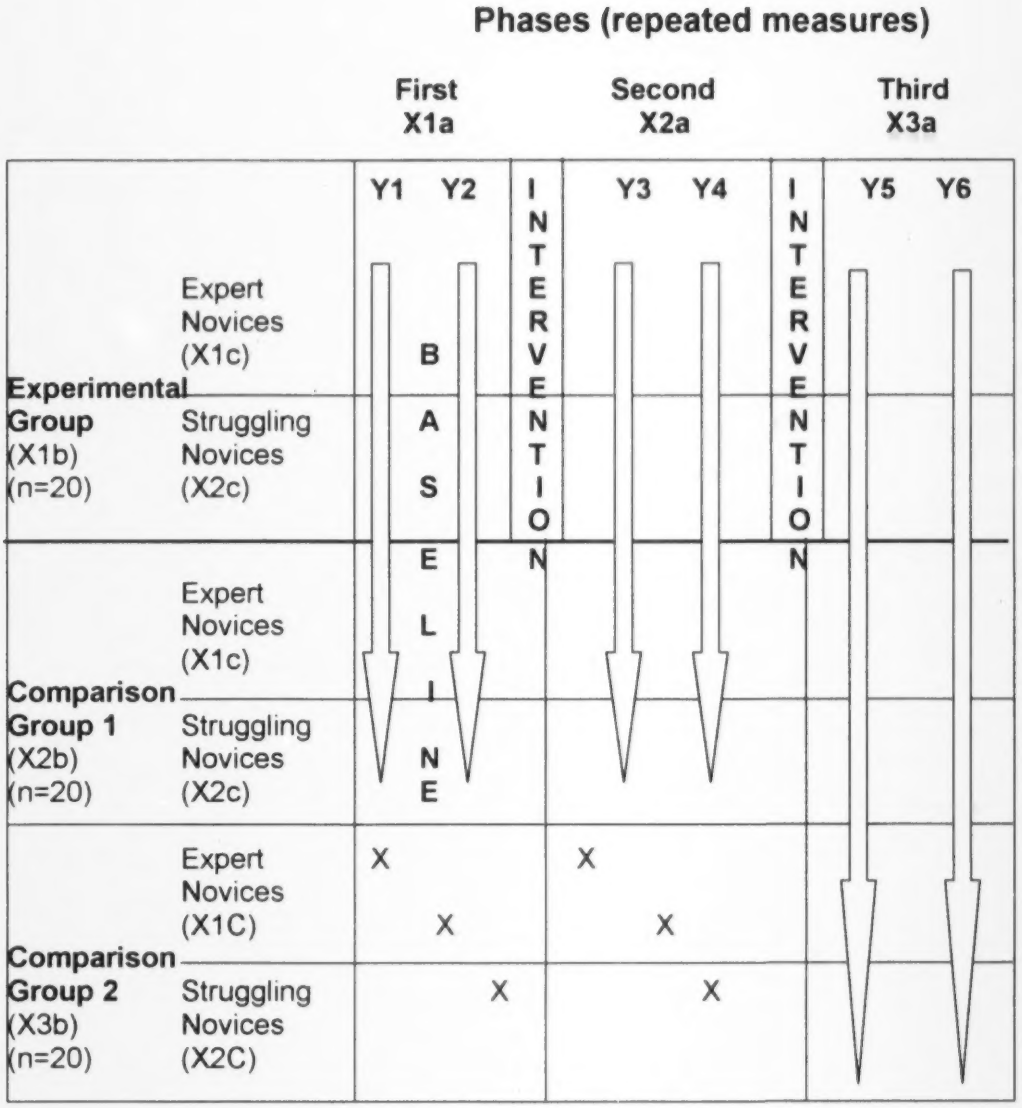



Figure 1. Conceptual framework for instructional scaffolding interventions in an educational psychology course.




- Where Independent Variables = Phases of Study (X1a – X3a).
  = Group (X1b – X3b).
  = Learner Types (X1c-X2c).

- Where Dependent Variables = Quality of Concept Map (Y1, Y3, Y5).
  = Written Expression of Conceptual Understanding (Y2, Y4, Y6).

Figure 2. Analytic Paradigm.

TABLE 1

INTERCORRELATIONS BETWEEN THE CRITERIA USED TO EVALUATE

MAPS AND ESSAYS FOR ALL PARTICIPANTS IN ALL PHASES

| | | m.Broadness | m.Depth Cat | m.Explanatory Focus | m.Fluency | m.Inclusive | m.Interpretability | m.Originality |
|---|---|---|---|---|---|---|---|---|
| Pearson Correlation | m.Broadness | 1.000 | -.013 | .359** | .332** | .390** | .223* | .001 |
| | m.Depth Cat | -.013 | 1.00 | .505** | .621** | .538** | .452** | -.142 |
| | m.Explanatory Focus | .359** | .505** | 1.000 | .664** | .732** | .504** | -.126 |
| | m.Fluency | .332** | .621** | .664** | 1.000 | .809** | .447** | -.197* |
| | m.Inclusive | .390** | .538** | .732** | .809** | 1.00 | .444** | -.183* |
| | m.Interpretability | .223* | .452** | .504** | .447** | .444** | 1.00 | -.003 |
| | m.Originality | 001 | -.142 | -.126 | -.197* | -.183* | -.003 | 1.00 |
| Sig. (2-tailed) | m.Broadness | . | .890 | .000 | .000 | .000 | .014 | .995 |
| | m.Depth Cat | .890 | . | .000 | .000 | .000 | .000 | .119 |
| | m.Explanatory Focus | .000 | .000 | . | .000 | .000 | .000 | .168 |
| | m.Fluency | .000 | .000 | .000 | . | .000 | .000 | .030 |
| | m.Inclusive | .000 | .000 | .000 | .000 | . | .000 | .044 |
| | m.Interpretability | .014 | .000 | .000 | .000 | .000 | . | .976 |
| | m.Originality | .995 | .119 | .168 | .030 | .044 | .976 | . |
| N | m.Broadness | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| | m.Depth Cat | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| | m.Explanatory Focus | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| | m.Fluency | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| | m.Inclusive | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| | m.Interpretability | 121 | 121 | 121 | 121 | 121 | 121 | 121 |
| | m.Originality | 121 | 121 | 121 | 121 | 121 | 121 | 121 |

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

**Correlations**

| | | w. Explanatory Focus | w.Fluency | w.Inclusive |
|---|---|---|---|---|
| Pearson Correlation | w. Explanatory Focus | 1.000 | .572** | .594** |
| | w.Fluency | .572** | 1.000 | .848** |
| | w.Inclusive | .594** | .848** | 1.000 |
| Sig. (2-tailed) | w. Explanatory Focus | | .000 | .000 |
| | w.Fluency | .000 | | .000 |
| | w.Inclusive | .000 | .000 | |
| N | w. Explanatory Focus | 116 | 116 | 116 |
| | w.Fluency | 116 | 116 | 116 |
| | w.Inclusive | 116 | 116 | 116 |

** Correlation is significant at the 0.01 level (2-tailed).

TABLE 2

CORRELATION BETWEEN CONCEPT MAPS AND ESSAYS

FOR ALL PARTICIPANTS IN ALL PHASES

| | | Map-Total Points | w.Total Points |
|---|---|---|---|
| Pearson Correlation | Map-Total Points | 1.000 | .568** |
| | w.Total Points | .568** | 1.000 |
| Sig. (2-tailed) | Map-Total Points | . | .000 |
| | w.Total Points | .000 | . |
| N | Map-Total Points | 121 | 116 |
| | w.Total Points | 116 | 116 |

**. Correlation is significant at the 0.01 level (2-tailed).

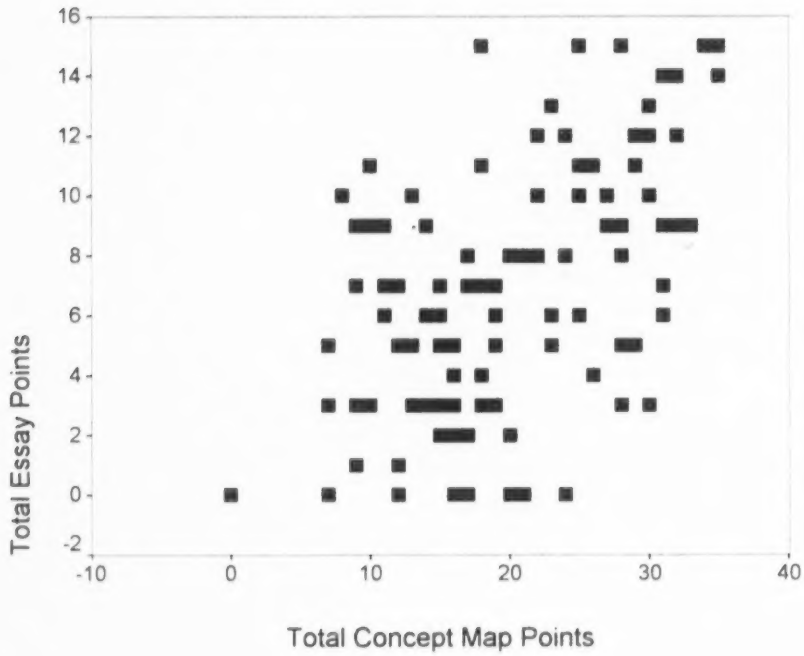



Figure 3. Scatter plot of the correlations between total concept map scores and total essay scores for all participants in all phases of the study.

TABLE 3

ONEWAY ANOVA BETWEEN THREE RATERS ON THIRTY DATA SETS OF MAPS AND ESSAYS

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| w explan | Between Groups | 1.489 | 2 | .744 | .462 | .632 |
| | Within Groups | 140.300 | 87 | 1.613 | | |
| | Total | 141.789 | 89 | | | |
| w flu | Between Groups | .156 | 2 | 7.778E-02 | .044 | .957 |
| | Within Groups | 154.967 | 87 | 1.781 | | |
| | Total | 155.122 | 89 | | | |
| W inclus | Between Groups | .200 | 2 | 1.000E-01 | .048 | .953 |
| | Within Groups | 181.400 | 87 | 2.085 | | |
| | Total | 181.600 | 89 | | | |
| W total | Between Groups | 822 | 2 | 411 | .033 | .968 |
| | Within Groups | 1082.967 | 87 | 12.448 | | |
| | Total | 1083.789 | 89 | | | |
| m Brdth | Between Groups | 1.756 | 2 | 878 | 1.1 | .339 |
| | Within Groups | 69.800 | 87 | 802 | | |
| | Total | 71.556 | 89 | | | |
| m Depth | Between Groups | 467 | 2 | 233 | .113 | .893 |
| | Within Groups | 179.133 | 87 | 2.059 | | |
| | Total | 179.600 | 89 | | | |
| m Explan | Between Groups | 356 | 2 | .178 | 076 | .927 |
| | Within Groups | 203.300 | 87 | 2.337 | | |
| | Total | 203.656 | 89 | | | |

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| m.Fluenc | Between Groups | 822 | 2 | .411 | .185 | .832 |
| | Within Groups | 193.667 | 87 | 2.226 | | |
| | Total | 194.489 | 89 | | | |
| m.Inclus | Between Groups | .200 | 2 | .100 | .033 | .968 |
| | Within Groups | 267.400 | 87 | 3.074 | | |
| | Total | 267.600 | 89 | | | |
| m.Inter | Between Groups | 4.356 | 2 | 2.178 | .893 | .413 |
| | Within Groups | 212.100 | 87 | 2.438 | | |
| | Total | 216.456 | 89 | | | |
| m.Orig | Between Groups | 2.689 | 2 | 1.344 | .723 | .488 |
| | Within Groups | 161.800 | 87 | 1.860 | | |
| | Total | 164.489 | 89 | | | |
| m.Total | Between Groups | 20.156 | 2 | 10.078 | .176 | .839 |
| | Within Groups | 4984.333 | 87 | 57.291 | | |
| | Total | 5004.489 | 89 | | | |

TABLE 4

Two Group MANOVA

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| Group | 1 | Experimental Group | 10 |
| | 2 | Comparison Group 1 | 10 |

**Multivariate Tests[c]**

| Effect | | Value | F | Hypothesis df | Error df | Sig | Noncent Parameter | Observed Power[a] |
|---|---|---|---|---|---|---|---|---|
| Intercept | Pillai's Trace | .940 | 83.903[b] | 3.000 | 16.000 | .00 | 251.709 | 1.000 |
| | Wilks' Lambda | .060 | 83.903[b] | 3.000 | 16.000 | .00 | 251.709 | 1.000 |
| | Hotelling's Trace | 15.732 | 83.903[b] | 3.000 | 16.000 | .00 | 251.709 | 1.000 |
| | Roy's Largest Root | 15.732 | 83.903[b] | 3.000 | 16.000 | .00 | 251.709 | 1.000 |
| GROUP | Pillai's Trace | .300 | 2.290[b] | 3.000 | 16.000 | .12 | 6.871 | .472 |
| | Wilks' Lambda | .700 | 2.290[b] | 3.000 | 16.000 | .12 | 6.871 | .472 |
| | Hotelling's Trace | .429 | 2.290[b] | 3.000 | 16.000 | .12 | 6.871 | .472 |
| | Roy's Largest Root | .429 | 2.290[b] | 3.000 | 16.000 | .12 | 6.871 | .472 |

a. Computed using alpha = .05

b. Exact statistic

c. Design: Intercept+GROUP

**Tests of Between-Subjects Effects**

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig | Noncent. Parameter | Observed Power[a] |
|---|---|---|---|---|---|---|---|---|
| Corrected Model | y1y2tot | 31.250[b] | 1 | 31.250 | .675 | .422 | .675 | .122 |
| | TOTY3Y4 | 42.050[c] | 1 | 42.050 | .347 | .563 | .347 | .086 |
| | TotY5Y6 | 627.200[d] | 1 | 627.200 | 6.565 | .020 | 6.565 | .679 |
| Intercept | y1y2tot | 9724.050 | 1 | 9724.050 | 209.947 | .000 | 209.947 | 1.000 |
| | TOTY3Y4 | 16994.45 | 1 | 16994.45 | 140.289 | .000 | 140.289 | 1.000 |
| | TotY5Y6 | 21255.20 | 1 | 21255.20 | 222.490 | .000 | 222.490 | 1.000 |
| GROUP | y1y2tot | 31.250 | 1 | 31.250 | .675 | .422 | .675 | .122 |
| | TOTY3Y4 | 42.050 | 1 | 42.050 | .347 | .563 | .347 | .086 |
| | TotY5Y6 | 627.200 | 1 | 627.200 | 6.565 | .020 | 6.565 | .679 |
| Error | y1y2tot | 833.700 | 18 | 46.317 | | | | |
| | TOTY3Y4 | 2180.500 | 18 | 121.139 | | | | |
| | TotY5Y6 | 1719.600 | 18 | 95.533 | | | | |
| Total | y1y2tot | 10589.00 | 20 | | | | | |
| | TOTY3Y4 | 19217.00 | 20 | | | | | |
| | TotY5Y6 | 23602.00 | 20 | | | | | |
| Corrected Total | y1y2tot | 864.950 | 19 | | | | | |
| | TOTY3Y4 | 2222.550 | 19 | | | | | |
| | TotY5Y6 | 2346.800 | 19 | | | | | |

a. Computed using alpha = .05

b. R Squared = .036 (Adjusted R Squared = -.017)

c. R Squared = .019 (Adjusted R Squared = -.036)

d. R Squared = .267 (Adjusted R Squared = .227)

Table 5

MEAN TOTAL SCORES FOR EXPERIMENTAL AND COMPARISON GROUP FOR EACH PHASE

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Included | | Excluded | | Total | |
| | N | Percent | N | Percent | N | Percent |
| y1y2tot * Group | 34 | 56.7% | 26 | 43.3% | 60 | 100.0% |
| TOTY3Y4 * Group | 22 | 36.7% | 38 | 63.3% | 60 | 100.0% |
| TotY5Y6 * Group | 40 | 66.7% | 20 | 33.3% | 60 | 100.0% |

**Report**

| Group | | y1y2tot | TOTY3Y4 | TotY5Y6 |
|---|---|---|---|---|
| Experimental Group | Mean | 20.06 | 29.33 | 33.10 |
| | N | 18 | 12 | 20 |
| | Std. Deviation | 7.75 | 9.65 | 10.68 |
| Comparison Group 1 | Mean | 20.63 | 27.70 | 24.80 |
| | N | 16 | 10 | 20 |
| | Std. Deviation | 5.28 | 11.80 | 11.46 |
| Total | Mean | 20.32 | 28.59 | 28.95 |
| | N | 34 | 22 | 40 |
| | Std. Deviation | 6.61 | 10.45 | 11.71 |

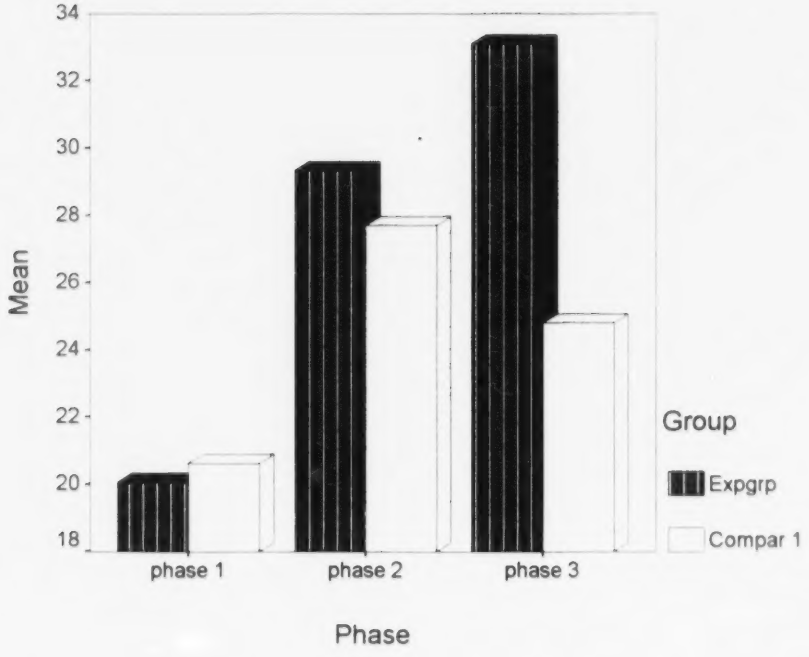



Figure 4. Mean total scores for experimental group and comparison group 1 for all phases.

TABLE 6

MEAN MAP AND ESSAY SCORES IN EACH PHASE FOR ALL GROUPS

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Included | | Excluded | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Y1tot * Grp | 34 | 56.7% | 26 | 43.3% | 60 | 100.0% |
| Y2 Tot * Grp | 34 | 56.7% | 26 | 43.3% | 60 | 100.0% |
| y1y2tot * Grp | 34 | 56.7% | 26 | 43.3% | 60 | 100.0% |
| Y3 Tot * Grp | 27 | 45.0% | 33 | 55.0% | 60 | 100.0% |
| Y4 Tot * Grp | 22 | 36.7% | 38 | 63.3% | 60 | 100.0% |
| TOTY3Y4 * Grp | 22 | 36.7% | 38 | 63.3% | 60 | 100.0% |
| Y5tot * Grp | 60 | 100.0% | 0 | 0% | 60 | 100.0% |
| Y6Tot * Grp | 60 | 100.0% | 0 | 0% | 60 | 100.0% |
| TotY5Y6 * Grp | 60 | 100.0% | 0 | 0% | 60 | 100.0% |

**Report**

| Grp | | Y1tot | Y2 Tot | y1y2 tot | Y3 Tot | Y4 Tot | TOT Y3Y4 | Y5tot | Y6T ot | TotY5 Y6 |
|---|---|---|---|---|---|---|---|---|---|---|
| Experimental Group | Mean | 15.50 | 4.56 | 20.06 | 21 | 6.17 | 29.33 | 23.60 | 9.50 | 33.10 |
| | N | 18 | 18 | 18 | 17 | 12 | 12 | 20 | 20 | 20 |
| | Std Deviation | 5.70 | 3.28 | 7.75 | 8.5 | 2.79 | 9.65 | 7.43 | 4.14 | 10.68 |
| Comparison Group 1 | Mean | 15.37 | 5.25 | 20.63 | 20 | 7.70 | 27.70 | 19.15 | 5.65 | 24.80 |
| | N | 16 | 16 | 16 | 10 | 10 | 10 | 20 | 20 | 20 |
| | Std Deviation | 4.44 | 2.24 | 5.28 | 11 | 3.13 | 11.80 | 7.80 | 5.34 | 11.46 |
| Comparison Group 2 | Mean | | | | | | | 25.10 | 9.80 | 34.90 |
| | N | | | | | | | 20 | 20 | 20 |
| | Std Deviation | | | | | | | 6.80 | 4.20 | 9.73 |
| Total | Mean | 15.44 | 4.88 | 20.32 | 21 | 6.86 | 28.59 | 22.62 | 8.32 | 30.93 |
| | N | 34 | 34 | 34 | 27 | 22 | 22 | 60 | 60 | 60 |
| | Std Deviation | 5.07 | 2.82 | 6.61 | 9.3 | 2.98 | 10.45 | 7.66 | 4.90 | 11.37 |

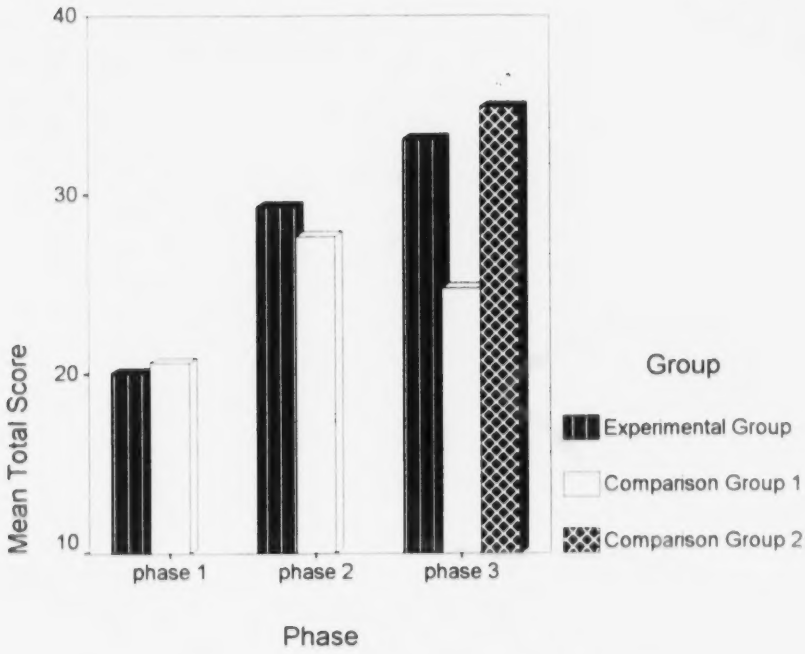



Figure 5. Total mean scores in each phase for all groups.

TABLE 7

ANOVA FOR MEAN TOTAL SCORE AMONG ALL GROUPS IN PHASE THREE

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| TOTY1Y2 | Between Groups | 2.747 | 1 | 2.747 | .061 | .806 |
| | Within Groups | 1438.694 | 32 | 44.959 | | |
| | Total | 1441.441 | 33 | | | |
| TOTY3Y4 | Between Groups | 14.552 | 1 | 14.552 | .128 | .725 |
| | Within Groups | 2278.767 | 20 | 113.938 | | |
| | Total | 2293.318 | 21 | | | |
| TotY5Y6 | Between Groups | 1160.933 | 2 | 580.467 | 5.120 | .009 |
| | Within Groups | 6462.800 | 57 | 113.382 | | |
| | Total | 7623.733 | 59 | | | |

TABLE 8

TUKEY POST HOC TEST OF PHASE 3 FOR ALL GROUPS

**Multiple Comparisons**

Dependent Variable: TotY5Y6

Tukey HSD

| (I) Grp | (J) Grp | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Experimental Group | Comparison Group 1 | 8.30* | 3.367 | .044 | .20 | 16.40 |
| | Comparison Group 2 | -1.80 | 3.367 | .855 | -9.90 | 6.30 |
| Comparison Group 1 | Experimental Group | -8.30* | 3.367 | .044 | -16.40 | -.20 |
| | Comparison Group 2 | -10.10* | 3.367 | .011 | -18.20 | -2.00 |
| Comparison Group 2 | Experimental Group | 1.80 | 3.367 | .855 | -6.30 | 9.90 |
| | Comparison Group 1 | 10.10* | 3.367 | .011 | 2.00 | 18.20 |

*. The mean difference is significant at the .05 level.

**TotY5Y6**

Tukey HSD[a]

| Grp | N | Subset for alpha = .05 | |
|---|---|---|---|
| | | 1 | 2 |
| Comparison Group 1 | 20 | 24.80 | |
| Experimental Group | 20 | | 33.10 |
| Comparison Group 2 | 20 | | 34.90 |
| Sig. | | 1.000 | .855 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 20.000.

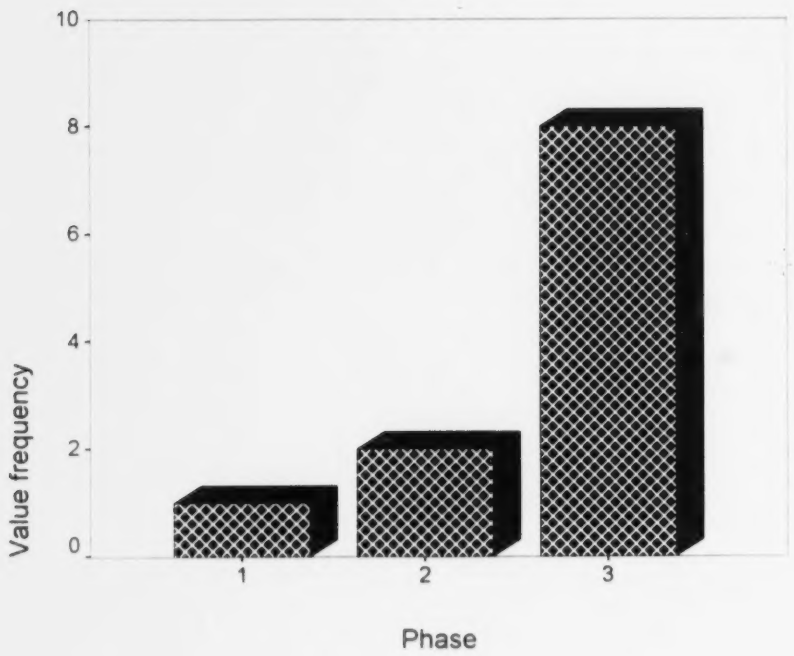



Figure 6. Number of expert-novices in each phase for experimental group.

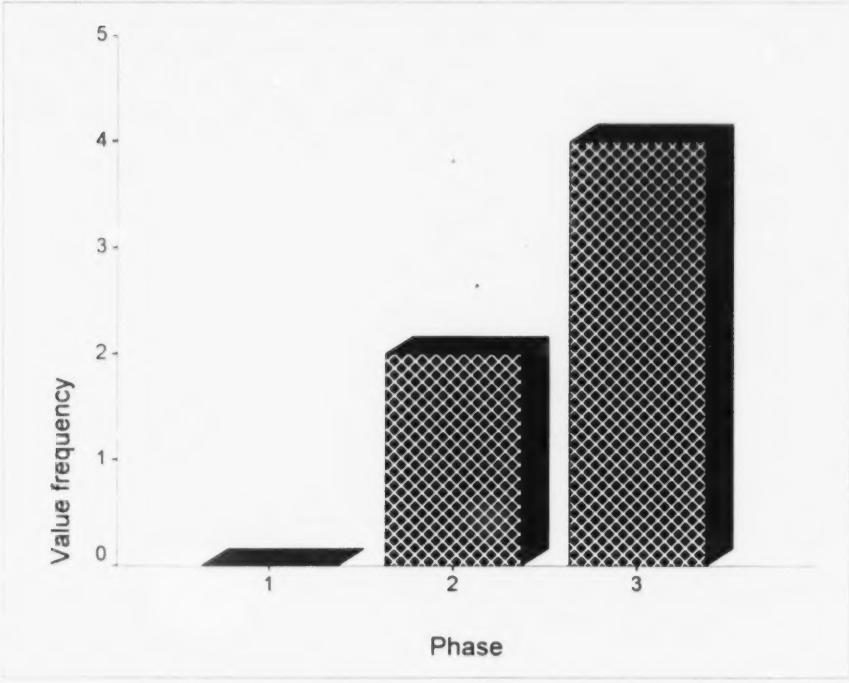
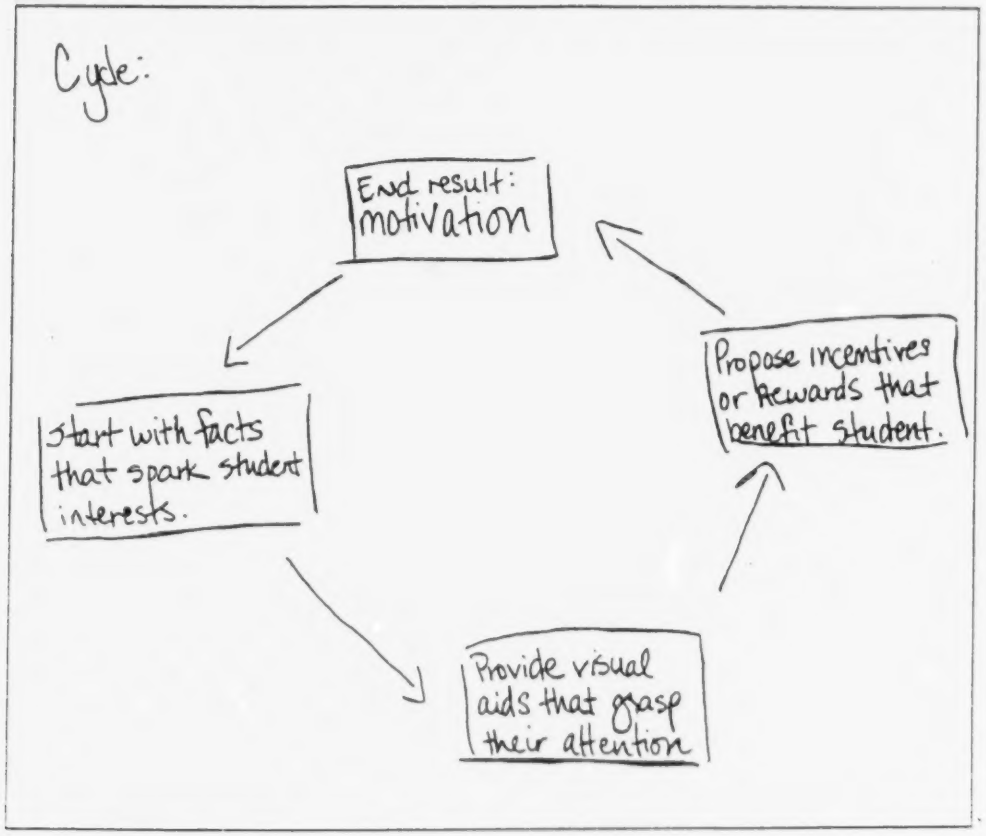



Figure 7. Number of expert-novices in each phase for comparison group 1.

APPENDIX A

(Press firmly on paper)


Cycle:
End result: motivation
Propose incentives or rewards that benefit student.
Start with facts that spark student interests.
Provide visual aids that grasp their attention

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Elliot seems to need more motivation in just the basics. He may not be aware of his capabilities because he is not interested thus accepting less of himself. Although he does like to flaunt a job well done.

Bill needs no motivation for his interests but rather for their importance. He needs to understand that his interests can be put to good use through his test taking.

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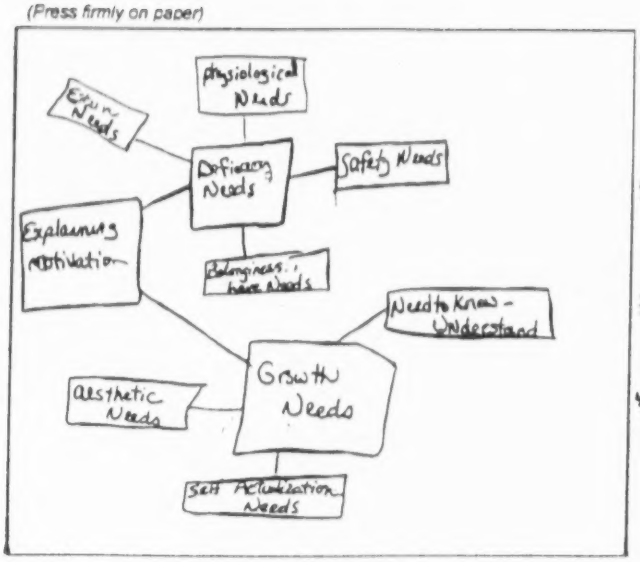
APPENDIX B

(Press firmly on paper)




2) doesn't explain motivation it tells you what you need to provide motivation

1) Has some flexibility but it is a little confusing

3) contains linking words, unsure if they are really linking though

4) It is original.

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APPENDIX C

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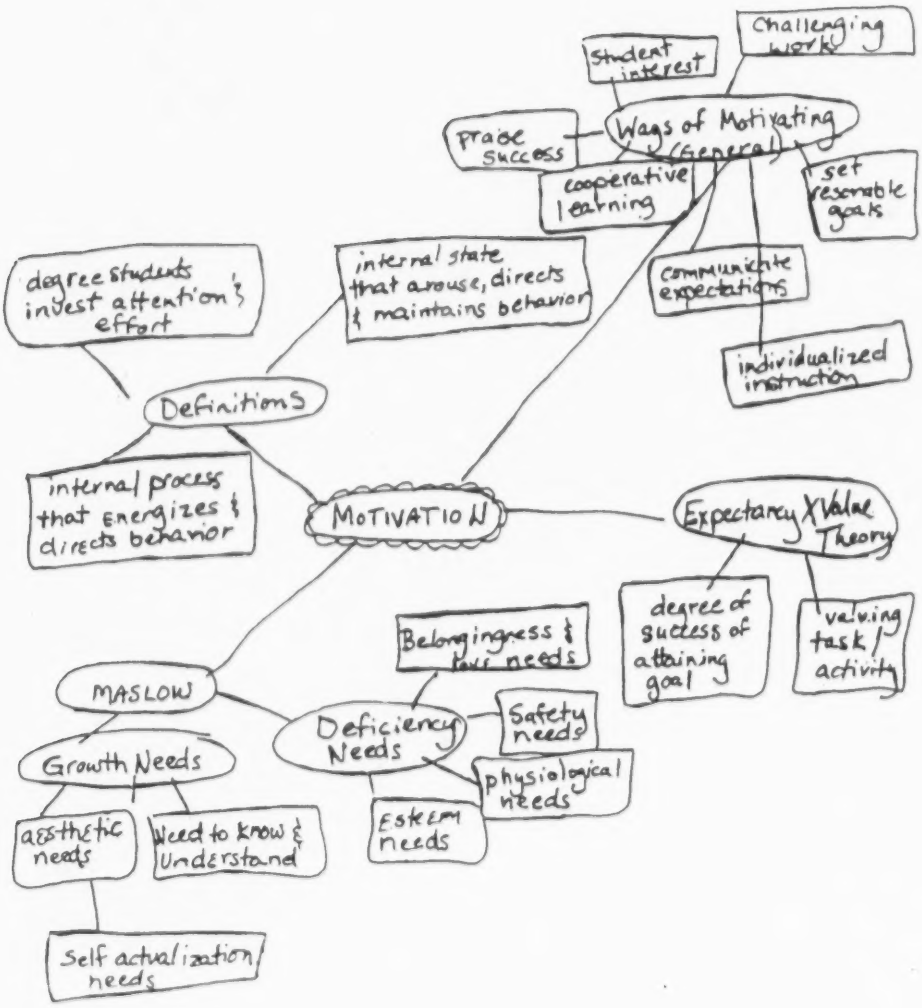


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